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U.S. EPA Enforcement Approach to Asbestos Site Cleanup

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ABSTRACT

A number of asbestos-contaminated sites are listed on the National Priorities List or have been considered for U.S. EPA emergency actions. Of these, four have been the subject of intensive U.S. EPA enforcement efforts to obtain site cleanup by potentially responsible parties. Considerations used in selecting the appropriate remedial response at each of these sites will be discussed and the final cleanup action will be described.

INTRODUCTION

Superfund has been used to accomplish cleanup at a number of National Priorities List (NPL) and non-NPL sites where the primary or only contaminant of concern is asbestos. National Priority List sites include: Mountain View Mobile Home Estates, Globe, Arizona; Coalinga Asbestos Mine, Coalinga, California; Atlas Asbestos Mine, Fresno County, California; Ambler Asbestos Piles, Ambler, Pennsylvania. Non-NPL sites include ten sites in and around Hudson, New Hampshire; the Jaquays Mill site, Globe, Arizona; and the Lloyd Hodges site, East Chicago, Indiana. Many of these sites were or are involved in enforcement actions under RCRA §7003 or CERCLA §106.

In this paper, the author will describe the approach taken in selecting remedial action at sites which are/were the subject of intense enforcement involvement. Considerations used in selecting or approving the appropriate remedies at these sites will be outlined and the final cleanup actions will be described.

ASBESTOS

Scientific Status

The definition of asbestos listed in the Glossary of Geology[1] is:

- A commercial term applied to a group of highly fibrous silicate minerals that readily separate into long, thin, strong fibers of sufficient flexibility to be woven, are heat resistant and chemically inert, and suitable for uses (as in yarn, cloth, paper, paint, brake linings, tiles, insulation cement, fillers and filters), where incombustible, nonconducting, or chemically resistant material is required.

- A mineral of the asbestos group, principally chrysotile (best adapted for spinning) and certain fibrous varieties of amphibole (example: tremolite, actinolite, and crocidolite)."

Inhalation of asbestos fibers is known to cause cancer in humans. Specifically, exposure to asbestos can cause bronchogenic carcinomas in the lung and pleural and peritoneal mesotheliomas after a latency period of up to 30 years. Asbestos is also known to lead to respiratory asbestosis, characterized by fibrosis, calcification and fibrosis of the pleura.[2] There is very limited information from which to infer the danger of cancer from ingestion of asbestos fibers in food or drinking water.

Legal Status

Asbestos is listed as a hazardous air pollutant under the Clean Air Act (CAA), section 112. Asbestos air emissions are regulated by the National Emissions Standards for Hazardous Air Pollutants (NESHAPS) at 40 *CFR* Part 61, Subpart M. Asbestos is listed as a toxic pollutant under section 307(a)(1) of the Federal Water Pollution Control Act (FWPCA). Asbestos is regulated in workplaces by OSHA (29 *CFR* Part 1910) and in schools by the U.S. EPA under the Toxic Substances Control Act (TSCA).

Although asbestos is not a hazardous waste listed under the RCRA regulations (40 *CFR* Part 261), its disease-causing properties meet the standards of the statutory definition of RCRA §1004(s). This toxic property of asbestos allows use of the substantial hazard standard of RCRA §3013 and the imminent and substantial endangerment standard of §7003 for enforcement purposes. Because of its listing in CAA and FWPCA, asbestos is, by definition, a hazardous substance under CERCLA §101(14), enabling the U.S. EPA to take removal or remedial action with the Superfund or to take enforcement action for cleanup through administrative orders or judicial actions under §106, and for cost recovery under §107.

Several enforcement actions have tested the U.S. EPA's response and enforcement authorities. The U.S. EPA has prevailed in these actions. In 1983, after oral argument and testimony in U.S. v. Johns Manville *et al.*, the U.S. District Court of New Hampshire found "that there has been a release or there exists a substantial threat of a release in the environment of a hazardous substance as contemplated by §104(a)(1) of CERCLA" and ordered two defendants to allow the U.S. EPA access to their property to conduct a removal action (installation of a cap). In 1984, in U.S. v. Metate Asbestos *et al.*, the U.S. District Court of Arizona found, on a partial summary judgment motion, that asbestos is a hazardous substance under the definition at §101(14) by virtue of the fact that asbestos is regulated under Section 307(a) of FWPCA and under Section 112 of Clean Air Act. The court ruled against the defendants' interpretation of the RCRA exclusion of mining wastes.

SITE INVESTIGATION/CHARACTERIZATION

The development and selection of remedies at asbestos sites varies little in its process from the process used at any other hazardous waste site. On one hand, decisions are made easier because there is no information indicating subsurface lateral or downward movement of asbestos in a landfill and asbestos is not a regulated hazardous waste under RCRA subtitle C. However, site investigations are made more difficult because analysis and quantification of asbestos is both complex and difficult to interpret.

Sampling

As with any other hazardous waste site, it is important to determine the scope of the contamination and possible movement or transport of the hazardous substance off-site. Asbestos sites dealt with under Superfund have primarily been the result of waste disposal from mining, milling or manufacturing facilities in the immediate area of the site. Asbestos contamination of soils is the result of either on-site waste disposal activities or the result of off-site deposition of asbestos particles through soil erosion from surface water or wind. There is no evidence to date of significant subsurface downward or lateral migration in soils. However, there may be upward movement of asbestos particles or products due to freeze-thaw effects common to rock migration in northern and New England soils. There is no documentation of groundwater transport of asbestos particles.

Surface soils and soil cores should be taken to investigate the areal extent and depth of contamination at and around the site. Site vegetation can be sampled after a wind or rain storm to investigate whether asbestos may have been transported from the soil, into the air and resettled on vegetation. Wipe samples should be taken from buildings or equipment on-site. If the site contains buildings or equipment which have air filters, these filters can be sampled.

Air sampling may be the next logical step. This analysis requires fairly sophisticated design procedures and may involve weeks or months of continuous sampling with many air sampling devices. Prior consultation with specialists in asbestos and particulate sampling is recommended, particularly if an enforcement action is involved. Experts differ in their desire for air sampling data to support their testimony that populations on or surrounding the site may be endangered. It is very difficult and potentially very costly to design an air sampling program which actually produces results useful for estimating population exposure.

Modelling studies may be quite useful in estimating typical and worst case air transport if the following information is available: meteorological conditions (wind direction and speed, temperature), soil and asbestos particle size and density, soil and air moisture conditions, site activity, site topography and asbestos concentrations. It may be time-consuming and of questionable cost-effectiveness to attempt to verify modelling results with an intensive air sampling regime, depending on the estimated cleanup cost for the site and the financial viability of responsible parties.

As with any site, historical land use records and photographs may be useful in directing the sampling efforts. Because visible emissions from asbestos milling, storage, manufacturing and disposal sites are a violation of NESHAPS, photographs or documentation of these occurrences may be valuable both for their evidence of the air transport of the wastes and as a basis for a Clean Air Act count in any enforcement action.

Information about site activities is also useful in alleging or estimating exposure to asbestos. In one toxic torts case, the plaintiffs went so far as to operate lawn mowers, motor bikes, rototillers, etc. on a residential site with personnel monitors and environmental air monitors to record the asbestos entrained in the air and available in the breathing zone. This may or may not be necessary, fruitful or desirable depending on the needs of the asbestos experts retained to work on the case. Some small amount of literature exists which could be extrapolated to these activities. Case-specific decisions should be made balancing costs, benefits and uncertainties.

Analysis

There are a number of uncertainties resulting from the difficulties of selecting a method of analysis, performing the analysis and interpreting and applying the results. A number of methods are used for the identification and quantitation of asbestos in air, water and soils. Optical polarized light microscopy, transmission electron microscopy, scanning electron microscopy and x-ray diffraction are useful but limited methods. Langer[3] describes these methods in some detail.

Electron microscopy is most expensive and takes the longest time to perform but will detect the smallest fibers. Polarized light microscopy can be done on-site or by many nearby laboratories for less time and money, but may be limited in its detection capabilities. If the point of the sampling is to demonstrate to the court that asbestos has definitely been released into the air and cost and time are not obstacles, then electron microscopy may be the method of choice.

If real time monitoring data are needed during a phase of cleanup, then an on-site laboratory with polarized light microscopy capabilities may be the most useful. Choose the analytical method that best fits your short- and long-term needs, timing and budget. Consult with your analytical laboratory during the design of sampling plans so that the analytical regime matches the rigorousness of your sampling. If you are involved in an enforcement case, consult with your asbestos expert witnesses regarding their needs and experience.

The most difficult problem is to relate the number of percentage of fibers reported in the analysis to the quantity of asbestos in a soil sample. A direct concentration (ppm or % by weight) is not reported; rather, analysts give the number or percentage of asbestos fibers per microscope field examined. Relating these data to traditional methods of interpreting data and estimating exposure potential is difficult. Air samples offer seemingly more direct results of numbers of fibers per liter of air across the filter. However, the sampling design is more difficult because the variables may be more difficult to control.

In general, it can be logically argued that asbestos documented on the surface of a site can be, and is, transported off-site by wind and by surface water runoff, to later be available for re-entrainment and subsequent exposure.

FEASIBILITY STUDIES/REMEDIAL DESIGN

At this point in time, there is only one option for permanent disposal of asbestos; that option is burial. There are several ways to accomplish this result depending on the size of the site and the volume of asbestos-contaminated soil: (1) excavation, transport, off-site landfilling; (2) burial in an on-site pit or landfill; (3) cap in place.

Because asbestos is neither a waste listed nor regulated under RCRA, disposal sites do not have to conform to subtitle C standards. Off-site disposal of asbestos wastes from a Superfund site may require a justification to be exempt from the U.S. EPA/OSWER Off-site Disposal Policy which requires Superfund wastes to be disposed of only at sites with RCRA permits and a good compliance record. At the time of this paper, the issue had not been raised on a site-specific basis. However, adequate arguments that asbestos wastes do not require the groundwater protections inherent in the Subtitle C landfill permitting process can be made. General requirements for solid waste disposal under RCRA do apply (40 *CFR* Part 257).

Under the Clean Air Act, NESHAPS requires closure of an asbestos site by covering the asbestos material with at least 6 in. of compacted clean fill material and vegetation or 24 in. of compacted clean fill material (no vegetation) or a resinous or petroleum based dust suppression agent. The drawback of the latter method is that the dust suppression agent must be reapplied at least yearly to maintain maximum effectiveness.

A general discussion of asbestos waste management is given in U.S. EPA publication number 530-SW-85-007, May 1985, entitled "Asbestos Waste Management Guidance."[4] Choice of a remedial option should be based upon a number of factors in addition to RCRA and NESHAPS. In some cases, the minimum required standards may be inadequate for a long-term remedial response. As mentioned above, dust suppression agents have a finite short life, 6 in. of fill may not be an adequate cap in difficult climates or steep topography and vegetation may be difficult to establish or maintain. In its enforcement actions, the U.S. EPA has focused on obtaining a remedy adequate for 30 to 50 years.

The following considerations have been used in selecting, recommending and/or approving remedies at RCRA and Superfund enforcement sites:

- Present site use, extant buildings and structures
- Site accessibility to the public
- Concentration of asbestos in the soil or wastes
- Volume of asbestos-contaminated soil or wastes
- Areal extent of surface contamination
- Depth of contamination
- Site safety procedures during remedial work
- Topography
- Climate—temperature, rainfall, storm events
- Vegetation establishment and maintenance
- Future maintenance requirements
- Future use

Decision #1: On-Site or Off-Site

The first decision to be made is whether the remedial action should take place on-site or off-site. The primary considerations in making this decision are site use, site accessibility and the concentration and volume of asbestos contaminated soil on the site. Future use may also be a consideration if the site is zoned for residential or industrial use.

The extent and volume of contamination contribute directly to the decision as to the practicality and cost of excavation and off-site transport. On several sites in New Hampshire, asbestos manufacturing bag wastes were used as fill in marshy areas or ravines. Because of the depth of possible excavation and the large amount of waste to be transported, it was deemed more cost-effective to ... the wastes in place. The concentration of asbestos in the soil and the accessibility of the site also contribute to the decision to excavate or cap in place.

On several smaller sites in New England, there was only a small surface area a foot or so in depth of contaminated soil. In these cases, it was more practical and more protective of health to remove the contamination and transport it to the local landfill for proper burial.

Residential sites should be looked at carefully to analyze the types and locations of activity and the locations of asbestos contamination. Certain typical suburban activities such as gardening and landscaping may preclude on-site disposal or capping.

As a result of a scope of contamination study performed at Mountain View Estates, Globe, Arizona, it was found that there was a fairly uniform distribution of asbestos over each residential lot. To adequately protect residents continuing to reside in the subdivision, there were three options other than permanent relocation: (1) installation of a cap in excess of 5 ft, (2) installation of a lesser cap with restrictions on any gardening, or (3) heavy use of the lots for recreational uses or (3) complete removal of all asbestos-contaminated soil. These options were rejected upon consideration of these and other factors discussed below. At one site in New Hampshire, a pocket of asbestos-contaminated fill was removed from a residential lot because it was deemed more protective of health and was feasible and cost effective to excavate.

A decision to transport off-site necessitates excavation of the wastes; and consequently, the health and safety of workers and nearby residents during the excavation and transport of the wastes, whether to an off-site or on-site landfill, is of concern. The scope and intensity of protective measures will affect the cost and feasibility of the job and the oversight required.

Residential Site Considerations

If there are residences on or adjacent to the site, sampling of settled dust should be done in those residences to determine whether asbestos has been transported from the site into them. Where there is information that asbestos attributable to the site is present in any building (aside from asbestos that may have been installed as insulation, siding or flooring) a decision must be made as to the feasibility of cleaning the building and its contents. A company skilled in asbestos cleanup in buildings should be consulted in the early stages of design to determine the best procedures and timing for cleaning.

It may be necessary to temporarily relocate nearby residents during times of intensive site work and building cleaning activities. The U.S. EPA temporarily relocated several families adjacent to sites in New Hampshire based on recommendations of the Centers for Disease Control and the judgement of the On-Scene Coordinator assisted by an industrial hygienist.

Permanent relocation is an option that should be considered in the same time period as the decision for off-site or on-site disposal. The U.S. EPA permanently located more than 20 families from mobile homes at the Mountain View Estates in Globe, Arizona, after deciding that the mobile homes could not be cleaned adequately unless the interior panel walls were removed and the air spaces between the walls were cleaned. Interior walls in mobile homes are not air tight; air and dust can infiltrate the spaces between the walls. One option was to purchase new trailers for installation on site. However, because of the uniform distribution of the asbestos contamination of the site, it was felt that a cap in excess of 5 ft might be needed to allow for normal suburban residential activities on the property. This was deemed to be not cost-effective. The residents were brought out; title to the property was assumed by the State of Arizona.

Decision #2: Cap in Place or Create On-Site Landfill

If it is decided to complete the remedy on-site, the second decision is whether to cap the contaminated area in place or to excavate and place the material in a burial pit or an on-site landfill. Again, the volume of the waste is a primary consideration.

Topography or the physical characteristics of the disposal site are also considerations because of wind and water erosion. If the wastes are in a large tailings pile or on a steep slope, it may be more secure for the long-term to remove the wastes to a burial pit or an area where they can be leveled off to the surrounding topography. A soil cover over a large steep sided pile may be a measure requiring a high degree of future maintenance because of the increased possibility of erosion. Health and safety considerations for workers and the surrounding population may play a part in the choice of capping in place or excavation to a new landfill site.

Cap Design

The design of a cap need not be strictly in accordance with RCRA regulations because, in the case of an asbestos closure, the cap serves a more limited purpose than for normal hazardous wastes; for asbestos, the purpose of the cap is to prevent remergence of the wastes on the surface of the site through the processes of wind and water erosion, freeze/thaw cycles and site use. At U.S. EPA enforcement sites, the nominal depth of the soil cap has varied from 6 in. to 5 ft, depending on topographical features, rainfall, winter temperature extremes, vegetation requirements, future maintenance requirements and future uses. Caps have been finished off with gravel, rip rap and/or vegetation depending on the foreseeable maintenance requirements, climate and aesthetics. In most enforcement actions, the U.S. EPA has been reluctant to accept the 6-in. plus vegetation minimum under NESHAP because of doubts about how long the cap would last due to erosion and continued site use.

The Corps of Engineers at the Cold Regions Research Laboratory in Hanover, New Hampshire has recommended a minimum of 2.5 ft of soil as a cap for New England sites because of research which found that there is an annual upward movement of pebbles, rocks and presumably asbestos particles through the action of freezing and thawing.[5] They recommend that the top of the asbestos layer be lower than the mean freeze line in the soil after the cap is installed.

The Arizona-Nevada Area Office of the Corps recommended a minimum of 2 ft of cover fill material at the Mountain View Estates site because of the desert climate and the potential for heavy storm erosion. The State of Arizona will assume maintenance responsibilities for this site after construction. However, a 5 ft layer of soil was chosen at the adjacent Jaquays site because of the higher concentration of asbestos in the tailings and the need to design a remedy with minimal future maintenance by the owner/operator.

Liners have been used at several sites, primarily to stabilize excavations or to indicate extensive erosion. The liners have been both PVC and woven filter fabric and have been used on top of rather than under the asbestos contamination. In Ambler, Pennsylvania, a matting layer of paper fibers in polypropylene was used on top of the clean fill to stabilize the steep slopes of the asbestos piles during the time it took for the vegetation to become established. Because there is no information that asbestos migrates downward or laterally, a bottom liner is not needed.

The depth of the cover or cap is relevant also to the ability to establish and maintain vegetation. Some asbestos wastes are highly alkaline and may be very high in magnesium. The New Hampshire and Pennsylvania sites have had pHs of 12 or more. Too little soil on top of the asbestos wastes could result in vegetation being unable to become established or dying after several seasons of growth. In addition, asbestos tailings are lacking in nutrients. If a lesser depth of soil is used for a cap, the maintenance requirements should require frequent fertilization and pH adjustment to maintain a healthy mat of vegetation.

Vegetation is recommended to stabilize the cover when adequate rainfall is available to maintain growth without irrigation. The Corps of Engineers and the Soil Conservation Service have been very helpful in selecting vegetation types, mostly grasses and ground covers such as crown vetch, that are adapted to specific climate regions and particular soil types. In areas with little natural rainfall or on steep slopes a gravel or rip rap finishing layer should be used in place of vegetation. Asphalt or concrete paving is another option for a cap, especially on sites which may be designated for industrial uses, parking lots or driveways.

SITE CONSTRUCTION WORK

Some general recommendations have been made to guide responsible parties in the drafting of health and safety plans. OSHA-approved respirators should be required. Work clothing need not be impermeable but should be disposable or able to be cleaned on site. Under no circumstances should workers take contaminated clothing off the site for cleaning. A number of epidemiology studies have suggested that contaminated clothing can be a significant source of exposure to families of asbestos workers.

Visible emissions are a violation of NESHAPS. They also endanger site personnel and contribute to off-site air transport. Special consideration must be given to dust control with water and dust suppressant. If the asbestos is in large tailings piles, as it has been at several sites, the interior of the piles may or may not have moisture content sufficient to prevent entrainment under light wind conditions during removal activities. A moisture content of 10% in addition to constant soaking during excavation to prevent moisture losses through evaporation is recommended in these situations.

Buildings on or adjacent to the site should be sealed to prevent dust infiltration. Air circulating equipment should be shut down and intake vents should be covered with sheets of plastic. Doors, windows and foundation and roof vents should be sealed with plastic, too. After the site work has been completed, buildings should be hosed off. Equipment used on the site should be cleaned prior to installation of clean cover material. Equipment air filters should be replaced prior to use on any other site.

MAINTENANCE PROVISIONS

Selection of cap design for either a burial pit or an above ground landfill should take into consideration the intensity of maintenance requirements and the presence of some private party, company or governmental entity to continue oversight, maintenance and repair of the cap. The less likely a party is to be able to continue intensive maintenance, the more important the depth of the cap and the choice of vegetation or finishing layer of rocks becomes. Consent decrees or orders should contain specific requirements for maintaining the integrity of the cap through regular fertilization, pH adjustment, mowing, reseeding of vegetation and regular checks and repairs of erosion damage or subsidence.

FUTURE USE OF PROPERTY

Deeds or property records should be noticed with the location, size and depth of buried asbestos wastes. Property where asbestos has been buried on-site can be used in ways limited only in so far as a cap or burial pit cover should not be disturbed. If it is necessary to disturb the cap, care should be taken to rebury asbestos-contaminated soil securely; strict health and safety procedures should be observed during additional construction. U.S. EPA consent decrees have included requirements for a deed notice and advance notification and prior approval of federal and state agencies for any activity which would disturb the cap over an asbestos waste disposal site.

CONCLUSIONS

An asbestos waste disposal site shares many considerations and features of its investigation, remedial design and remedial implementation with other hazardous waste sites. However, there are a number of important differences. Asbestos is not a regulated hazardous waste under RCRA Subtitle C but is a regulated hazardous air pollutant under the Clean Air Act. Asbestos is, however, a hazardous substance under CERCLA.

The primary endangerment from asbestos results from air transport and inhalation exposure. There is little evidence that asbestos moves downward or laterally in subsurface soils. The primary remedial response for asbestos is burial. There are three major means of accomplishing this response: (1) excavation, transport and off-site disposal; (2) excavation and on-site disposal; and (3) capping in place. A number of considerations are discussed in this paper for selection of remedies which are appropriate whether the government or a private party will perform the remedial construction.

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